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Appeal Brief (3)

Bates 4/24

IN THE UNITED STATES PATENT
AND TRADEMARK OFFICE

Group Art Unit 3988
Examiner Edward A. Miller

Graylon K. WILLIAMS, et al.

REVISED APPEAL BRIEF

Serial No. 09/664,130

Filed September 18, 2000

For: GAS GENERANTS CONTAINING SILICONE FUELS/ April 16, 2003

Box AF
Assistant Commissioner of Patents
Washington, D.C. 20231

Sir:

This is an appeal from the final rejection of claims 1-13 and 16-18 set forth in the office action mailed September 6, 2002. Applicants appreciate the opportunity to revise the brief relative to the examiner's concerns in Paper No. 13. Responsive revisions consistent with the examiner's comments have been made below. Concurrently herewith, Applicants petition for a one-month extension of time for the period of response and include the appropriate fee.

(1) Real Party of Interest:

The real party of interest in this appeal is Automotive Systems Laboratory, Inc., a Michigan corporation, the owner of the subject application by assignment.

(2) Related Appeals and Interferences:

There are presently no other appeals and/or interferences known to appellant, appellant's legal representative, or assignee which will directly affect or be directly affected by the Board's decision in the pending appeal.

I hereby certify that this correspondence is being deposited with the U.S. Postal Service with sufficient postage as first class ~~mail in an~~ envelope addressed to: Box AF, Assistant Commissioner of Patents, Washington, D.C. 20231, on April 16, 2003

Name of person mailing: Laurence C. Begin Signature: Laurence C. Begin Date 4/16/03

(3) Status of Claims:

Claims 1-13 and 16-18 are pending and stand finally rejected in an Office Action dated September 6, 2002 (Paper #10). Claims 14 and 15 are pending but have been withdrawn from consideration.

(4) Status of Amendments:

No Amendment was filed After the Final Rejection.

(5) Summary of the Invention:

The present gas generant composition solves the problems of excess combustion temperatures and relatively higher inflator operating pressures, and meets toxicity requirements given its stated suitability for use within a vehicle occupant restraint system. Typically, the need to pressurize an associated combustion vessel during combustion requires a more robust inflator and therefore increases the manufacturing costs.

Accordingly, a gas generant composition is provided that exhibits an acceptable and sustained burn rate at ambient pressure while avoiding excessive combustion temperatures. Furthermore, gas generant compositions of the present invention exhibit a ductility or elasticity that inhibits fracture of the gas generant over time. A gas generant composition of the present invention contains silicone as a fuel; an oxidizer selected from the group including metal and nonmetal perchlorates such as potassium perchlorate, lithium perchlorate, and ammonium perchlorate; and, a coolant selected from the group including metal carbonates, metal bicarbonates, metal oxalates, and metal hydroxides.

Preferred coolants will preferably exhibit a greater negative heat of formation. As such, dissociation of the coolant upon combustion of the gas generant composition generally results in an endothermic combustion reaction thereby resulting in a cooler combustion temperature. Furthermore, when coolants such as strontium carbonate are employed, silicates such as strontium silicate are formed thereby forming an insulation about the propellant as it burns, thus conserving heat.

As claimed in claim 1, the present invention includes silicone as a fuel, an

oxidizer selected from the group consisting of metal and nonmetal perchlorates, and a coolant selected from the group consisting of alkali, alkaline earth, and transitional metal carbonates, bicarbonates, oxalates, and hydroxides. As detailed on page 6 and in Table 1 of the specification, compositions containing silicone and a perchlorate oxidizer exhibit rapid and sustained burn rates (at 3000 psi) greater than or equal to one inch per second. At ambient pressure these compositions exhibit burn rates at approximately 0.4 inches per second or greater and provide adequate amounts of gas. An inherent benefit of a reduced operating pressure, therefore, is that inflators associated with these compositions exhibit satisfactory burn rates and gas production while reducing the necessity of a robust inflator design. However, without the coolant, compositions containing silicone and a perchlorate oxidizer may exhibit relatively high temperatures. See examples 2 and 3 as compared to examples 17, 21 and 24 of Table 1. As explained below, the prior art cited simply does not teach or suggest the compositions of the present invention. Stated another way, the prior art does not describe or suggest compositions exhibiting the multiple benefits of improved combustion properties at ambient operating pressure, a relatively lower operating temperature, and adequate amounts of gas.

(6) Issues:

Did the Examiner err in finally rejecting claims 1-13 and 16-18 as being unpatentable over Grebert et al. in view of Plantif et al., Hamilton, Ochi et al., Taylor et al., and Hackett et al. under 35 U.S.C. §103(a)?

(7) Grouping of Claims:

Claims 1-13 and 16-18 stand together as being rejected for the same reasons.

(8) Argument:

The basic reference applied against claims 1-13 and 16-18, namely U.S. Patent No. 3,986,908 to Grebert et al. does not respond to the positive limitations of claims 1 and 16, and all claims dependent thereon. Grebert does describe compositions containing silicone rubber and perchlorate oxidizers, but

he indicates a concern about the toxicity of the gases. See column 1, lines 22-35:

> Moreover, the use of conventional composite propellants as gas generators in inflatable cushion protection devices for high speed vehicles, such as automobiles, cannot be considered because these propellants do not fulfil the condition that the gases they produce ***should be non-toxic,***...(emphasis added)

Also see column 2, lines 28-45 where Grebert advises one of ordinary skill in the art that:

> [T]he preferred binders are cellulose acetates, particularly cellulose triacetate, and silicone rubbers, particularly silicone rubbers with a carbon content less than 33%. The preferred proportion of cellulose triacetate is from 8 to 17.2% by weight, and that of silicone rubber is from 8 to 14.6% by weight. Below 8% by weight, the binder does not coat the grains of oxidizing agent perfectly. The upper limit for the proportion of binder is determined by the ***necessity of obtaining a carbon monoxide content of not more than about 500 PPM on combustion....***(emphasis added)

Note that Grebert reduces the percent weight range of silicone rubber as compared to triacetate, implicitly concluding greater carbon monoxide production when silicone rubber is used.

Also see column 2, lines 49-55:

> Many plasticizers may be employed, the preferred being tricresyl phosphate, diethyl phthalate and triacetin. The best results with respect to mechanical strength and toxicity of the gases produced, are obtained with triacetin which, for the same weight of plasticizer, introduces the ***least carbon into the composition....***(emphasis added)

It is therefore clear that Grebert is especially concerned about managing the total carbon content in the composition. In view of the above, the addition of a carbonate or oxalate coolant for example, as claimed in the present invention, would apparently contravene the purposes of Grebert's invention, for carbon would be added to the overall composition, thereby providing additional carbon for the production of carbon monoxide.

This notion is particularly supported in view of the following:

> The preferred combustion accelerator is aluminium which preferably has a specific surface area of from 3400 to 3800 cm^2 per cm^3. See column 2, lines 46-48.

and see column 4, lines 30-45:

> The maximum aluminium is determined by the rise in the reaction temperature due to the exothermic properties of aluminium and which, in turn, leads to an increase in the carbon monoxide content of the combustion gases as shown in the following table:

Proportion of		CO at the neck of the pipe (PPM)		
Triacetate	0%Al	2%Al	3%Al	4%Al
8		9	32.2	8.0
10		42	103	261
12	17	126	288	514
14	75	317	600	1020
16	210	690	1360	3450
18	700	1635		

Note that as shown in the table, even though aluminium is preferably used as a combustion accelerator, the use of aluminium always results in additional amounts of carbon monoxide. Also note that the table reflects the use of triacetate as a binder, not silicone. Recall that as described above, the use of silicone would result in even more amounts of carbon monoxide and therefore the percent range is reduced relative to that of triacetate. Accordingly, the percentage of silicone would have to be reduced in order to keep the carbon monoxide below 500 PPM as required by Grebert. If carbon-containing coolants (e.g. carbonates and oxalates) were added the percentage of silicone would theoretically, based on the table given above, have to be reduced even further. Note that Grebert indicates a percent level below 8% as unsatisfactory.

In a nutshell, therefore, Grebert essentially teaches away from adding any other carbon-containing composition that would increase the

propensity for the production of carbon monoxide. As set forth above by Grebert, one of ordinary skill in the art upon review of U.S. Patent No. 3,986,908 would conclude that the addition of a carbon-containing coolant would simply cut against Grebert's efforts to minimize carbon-monoxide production.

But Grebert also teaches away from the use of a coolant of the present invention by virtue of his use of an ***exothermic*** combustion accelerator. As explained by the applicants on page 3, lines 2-4 for example:

> Accordingly, dissociation of the coolant upon combustion of the gas generant composition ***results in an endothermic combustion reaction thereby resulting in a cooler combustion temperature.,***...(emphasis added)

As explained above, the combustion of the gas generant composition containing a combustion accelerator would result in higher temperatures due to the exothermic character of the combustion accelerator. Accordingly, one of ordinary skill in the art would not be motivated ***to increase*** the temperature of the combustion and concurrently ***decrease the temperature*** with the use of a carbon-containing coolant. Stated another way, the use of an endothermic coolant is counterintuitive to the stated reason for the use of a combustion accelerator, namely to increase (not decrease) the combustion temperature.

As detailed in paper No. 9, (the Request for Reconsideration filed on 12 August 2002), the other references cited do not cure the deficiencies of Grebert. In essence, they either teach away, or simply lack any motivation or suggestion to combine the references.

Plantif et al recognizes the benefit of forming compositions containing perchorate oxidizers and silicone resin. Plantif also recognizes the benefit of coolants, but **teaches away** from their use in solid propellants when the gases to be produced are non-toxic (as in occupant restraint systems). See column 1, lines 12-31. As such, Plantif incorporates outboard coolants as recognized by the examiner, but does not contemplate or suggest the use of a coolant integral to the

gas generant composition. When a reference teaches away from an invention, it is well founded that it cannot suggest the same.

Hamilton also **teaches away** from the present invention. At column 1, lines 45-50, Hamilton summarizes the invention:

> In accordance with the present invention, a combustible mixture of carbon, an oxidizer which does not contain hydrogen and, optionally, a coolant are mixed to form a combustible material which produces non-toxic gas rapidly, at relatively low temperature, and ***without the production of water vapor***. (Emphasis added)

Silicone, as described in Formulas 1 and 2 of the present invention, for example, often contains an abundant amount of hydrogen. This contravenes Hamilton because of the propensity for compositions containing silicone to produce at least minimal amounts of water.

Ochi et al. does not suggest any fuel (or reducing agent) other than HDCA or hydrazodicarbonamide. The structure of HDCA is markedly different from silicone. Compare Formula 1 of Ochi with Formulas 1 and 2 of the present invention. The examiner's attention is also directed to Tables 2, 5, and 6 as found in Ochi. The "In-tank gas temperature (°C)" resulting from combustion of compositions described by Hamilton ranges from 152 to 407 °C. When viewed in light of Ochi's objects of the invention as described in column 2, lines 5-35 (e.g. low combustion temperature), one of ordinary skill in the art would not be motivated to replace the low heat generating HDCA with silicone. The use of silicone results in temperatures in excess of 2000°C as given in Table 1 on pages 6 and 7 of the specification. Therefore, Ochi et al. also **teaches away** from the present invention.

Although Taylor describes the use of perchlorates in compositions, the similarity ends there. Neither does Taylor offer any motivation or suggest formulation of the present compositions when viewed in light of Grebert. Taylor has as an object of the invention, production of an easily extrudable composition that is readily cured at room temperature, and mixed at low viscosity. See the

"Summary of the Invention". These objects simply differ from the benefits characterized in the present invention. As such, one of ordinary skill in the art would not be motivated to consider Taylor when formulating the present compositions. A prima facie case of obviousness cannot be supported without the requisite showing of a suggestion or motivation to combine the references. Again, Taylor falls short in this regard.

Finally, in the same way, Hackett fails to cure the deficiencies of the references cited. Although Hackett recognizes the usefulness of silicone and inorganic perchlorates, he does not offer any motivation or suggestion to combine silicone with a perchlorate oxidizer and a coolant.

In sum, none of the references when taken alone or when taken together suggest or describe the present invention. Stated another way, for the reasons given, a prima facie case of obviousness cannot be supported by references that teach away from the present invention, nor can it be supported without the requisite showing of a motivation to combine the references.

The examiner is advised that if the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious. *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959). Adding carbon-containing coolants to the compositions of Grebert would certainly change the principle of operation given that an endothermic reaction would occur rather than the preferred exothermic reaction as described above.

The examiner is further advised that it is improper to combine references where the references teach away from their combination. *In re Grasselli*, 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir. 1983). Certainly, Grebert teaches away from adding any additional component (other than those described) that would contribute to any increase in carbon monoxide combustion products. The table in column 4 illustrates the ease of carbon monoxide formation, particularly at higher temperatures and under pressurized conditions. Grebert's admonitions against increasing the carbon amount dissuade rather than

persuade one of ordinary skill to proceed by adding more carbon.

Finally, the examiner is yet further advised that proceeding contrary to accepted wisdom in the art is evidence of nonobviousness. *In re Hedges*, 783 F.2d 1038, 228 USPQ 685 (Fed. Cir. 1986). Clearly, addition of carbon-containing coolants despite Grebert's admonitions against it cuts against the prevailing wisdom at the time of the present invention.

(9) Conclusion:

For the above-stated reasons, the examiner has simply not met the burden of substantiating a prima facie case of obviousness relative to claims 1-13 and 16-18. Most importantly, Grebert teaches away from adding an endothermic carbon-containing coolant. Similarly, the other references teach away or fail to suggest a combination of the references for the reasons stated. The requisite suggestion or motivation to combine the references is therefore lacking. Accordingly, reversal of the Examiner's rejection of claims 1-13 and 16-18 under 35 U.S.C. §103, and issuance of the present application is courteously solicited.

Applicant has calculated a fee of $110.00 for a one-month extension of time in connection with this revised brief. Our check is enclosed in that amount. The Commissioner is hereby authorized to charge any additional fees incident to the filing of this communication to Deposit Account No. 04-1131. A duplicate copy of the front page of this document is enclosed.

Respectfully submitted,

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(10) Appendix – Claims 1-13 and 16-18:

1. A gas generant composition comprising:
silicone as a fuel;
an oxidizer selected from the group consisting of metal and nonmetal perchlorates; and
a coolant selected from the group consisting of alkali, alkaline earth, and transitional metal carbonates, bicarbonates, oxalates, and hydroxides.

2. The gas generant composition of claim 1 further comprising:
a secondary oxidizer selected from the group consisting of metal and nonmetal nitrates.

3. The gas generant composition of claim 1 wherein said oxidizer is selected from the group consisting of potassium perchlorate, ammonium perchlorate, and lithium perchlorate.

4. The gas generant composition of claim 1 wherein said composition comprises:
silicone;
potassium perchlorate; and
strontium carbonate.

5. The gas generant composition of claim 1 wherein said composition comprises:
silicone;
potassium perchlorate; and
strontium oxalate.

6. The gas generant composition of claim 1 wherein said composition

comprises:
silicone;
potassium perchlorate; and
calcium oxalate.

7. The gas generant composition of claim 1 wherein said composition comprises:
silicone;
potassium perchlorate; and
calcium carbonate.

8. The gas generant composition of claim 1 wherein said composition comprises:
silicone;
potassium perchlorate; and
magnesium hydroxide.

9. The gas generant composition of claim 1 wherein said composition comprises:
silicone;
potassium perchlorate; and
magnesium carbonate.

10. The gas generant composition of claim 1 wherein said composition comprises:
silicone;
lithium perchlorate; and
a coolant selected from the group consisting of strontium carbonate, calcium carbonate, strontium oxalate, magnesium carbonate, magnesium hydroxide, and potassium carbonate.

11. A gas generant composition comprising:
silicone at 10-25%;
a primary oxidizer selected from the group consisting of metal and nonmetal perchlorates at 30-85%; and
a coolant selected from the group consisting of alkali, alkaline earth, and transitional metal carbonates, oxalates, bicarbonates, and hydroxides at 1-30%, said percentages stated by weight of said gas generant composition.

12. The gas generant composition of claim 11 further comprising:
at least one secondary oxidizer selected from the group consisting of nonmetal, alkali metal, alkaline earth metal, and transitional metal chlorates, nitrates, nitrites, and oxides at 30-50% by weight of said gas generant composition.

13. The gas generant composition of claim 12 wherein said at least one secondary oxidizer is selected from the group consisting of phase stabilized ammonium nitrate, ammonium nitrate, strontium nitrate, and potassium nitrate.

16. A gas generant composition comprising:
silicone at 10-25%;
potassium perchlorate at 30-85%; and
a coolant selected from the group consisting of alkali metal, alkaline earth metal, and transitional metal carbonates, oxalates, and hydroxides at 1-30%, said percentages stated by weight of said gas generant composition.

17. The gas generant composition of claim 16 comprising:
silicone at 10-25%;

potassium perchlorate at 30-85%; and

strontium carbonate at 1-30%, said percentages stated by weight of said gas generant composition.

18. The gas generant composition of claim 17 comprising:

silicone at 20%;

potassium perchlorate at 60%; and

strontium carbonate at 20%, said percentages stated by weight of said gas generant composition.